REMARKS

This Response is in response to the Office Action mailed on August 24, 2009. Claims 5 and 7-11 are pending with claims 10 and 11 being withdrawn.

§112, 1st Paragraph Rejection:.

Claims 5 and 7-9 are rejected as failing to comply with the written description requirement. In particular, the rejection asserts an "accelerated electron beam" emitted from the electron beam source is not supported in the specification. However, Applicants note that it would be understood by one skilled in the art at the time of the invention that in order for the electron beam to be used to evaporate the first thin film, the electron beam source must emit an accelerated electron beam in order to be capable of evaporating the first thin film material by heating.

Applicants also submit an article from Wikipedia on "Electron Beam Physical Vapor Deposition" (http://en.wikipedia.org/wiki/Electron_beam_physical_vapor_deposition) and a product marketing publication from JEOL for "Electron Beam Sources and Power Supplies", with the relevant portions highlighted, that provides further evidence that an accelerated electron beam is required in order to evaporate a thin film material. As discussed in the Wikipedia article, in a thin film deposition process a generated electron beam is accelerated in order to melt and evaporate a liquid ingot material (see the last full paragraph on page 1 of the Wikipedia article). The JEOL product marketing publication also lists a variety of electron beam sources each with the feature of an accelerating voltage for use in evaporating a material (see pages 2-8, 10 and 11 of the JEOL publication). Withdrawal of this rejection is requested.

§103 Rejections:

Claims 5, 7 and 9 are rejected as being unpatentable over DeLozanne (US Patent No. 5,004,721) in view of Higuchi (US Patent No. 5,079,224) and further in view of Yanai (US Patent No. 4,511,594). This rejection is traversed.

Claim 5 is directed to an apparatus for manufacturing a thin film in which the thin film is formed on a supporting base that recites, among other features, an electron beam source that is arranged in the vacuum container and emits an accelerated electron beam to

be used to evaporate the first thin film material by heating using an electron beam heating method. Claim 5 also recites that a path along which the accelerated electron beam emitted from the electron beam source reaches the electron beam evaporation source intersects with a line segment connecting the resistance heating evaporation source with the surface to be vapor-deposited.

The combination of DeLozanne and Higuchi does not teach or suggest these features. The rejection continues to rely on Higuchi for teaching a path along which the accelerated electron beam emitted from the electron beam source reaches the electron beam evaporation source intersects with a line segment connecting the resistance heating evaporation source with the surface to be vapor-deposited.

However, Applicants note that Higuchi does not teach that an electron beam is accelerated. Higuchi merely teaches that thermionic beams (unaccelerated electrons) intersect with evaporated streams of metallic elements in order to partially ionize the metallic streams, which allows the adhesion and crystallization of a resulting thin film to be improved (see column 3, lines 37-42 and column 4, lines 51-54 of Higuchi).

Accordingly, Higuchi cannot teach an apparatus that is configured such that a path along which the accelerated electron beam emitted from the electron beam source reaches the electron beam evaporation source intersects with a line segment connecting the resistance heating evaporation source with the surface to be vapor-deposited.

Further, it would not be obvious to one skilled in the art to modify the apparatus of DeLozanne with features of Higuchi to obtain the features of claim 5. The rejection argues that one skilled in the art would be motivated to modify the configuration of DeLozanne based on the teachings of Higuchi in order to ionize the barium prior to deposition to produce a superior thin film. However, one skilled in the art would not look to modify the configuration of DeLozanne, which uses an electron beam source 14a to evaporate yttrium (i.e., emits an accelerated electron beam), based on prior art that teaches a configuration that does not use an electron beam source to evaporate a metal.

Also, modifying the configuration of DeLozanne with features of Higuchi in order to ionize metallic streams would require replacing the electron beam source 14a, which is used to evaporate yttrium, with a thermionic beam generator 41-43 that does not evaporate a thin film but merely ionizes metallic streams (see column 3, lines 37-42 and

column 4, lines 51-54 of Higuchi). Thus, combining DeLozanne with Higuchi would result in a configuration in which an electron beam source is provided that does not emit an accelerated electron beam and therefore cannot evaporate a first thin film material, as required by the electron beam source of claim 5. Accordingly, it would not be obvious to one skilled in the art to modify the configuration of DeLozanne based on the teachings of Higuchi to obtain a configuration in which a path along which the accelerated electron beam emitted from the electron beam source reaches the electron beam evaporation source intersects with a line segment connecting the resistance heating evaporation source with the surface to be vapor-deposited, as recited in claim 5.

Yanai does not overcome the deficiencies of DeLozzane and Higuchi. It is irrelevant that Yanai teaches an electron beam source emitting an accelerated electron beam. Applicants note that DeLozzane already teaches an electron beam source that evaporates a thin film material, and therefore teaches an electron beam source that emits an accelerated electron beam. Thus, Yanai does not appear to impact the patentability of the claimed features.

For at least these reasons claim 5 is not suggested by the combination of DeLozanne, Higuchi and Yanai and should be allowed. Claims 7 and 9 depend from claim 5 and should be allowed for at least the same reasons.

Claim 8 is rejected as being unpatentable over DeLozanne in view of Higuchi and further in view of Suzuki (US Patent No. 4,622,919). This rejection is traversed. Claim 8 depends from claim 5 and should be allowed for at least the same reasons described above. Applicants do not concede the correctness of this rejection.

Conclusion:

Applicants respectfully assert that the pending claims are in condition for allowance. If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicants' primary attorney-of record, Douglas P. Mueller (Reg. No. 30,300), at (612) 455-3804.

53148
PATENT TRADEMARK OFFICE

Dated: November 18, 2009

Respectfully submitted,

HAMRE, SCHUMANN, MUELLER & LARSON, P.C.
P.O. Box 2902
Minneapolis, MN 55402-0902
(612) 455-3800

By:
James A. Larson
Reg. No. 40,443
JAL/ahk/jls

Electron beam physical vapor deposition

From Wikipedia, the free encyclopedia

Electron Beam Physical Vapor Deposition or **EBPVD** is a form of physical vapor deposition in which a target anode is bombarded with an electron beam given off by a charged tungsten filament under high vacuum. The electron beam causes atoms from the target to transform into the gaseous phase. These atoms then precipitate into solid form, coating everything in the vacuum chamber with a thin layer of the anode material.

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- 2 Thin film deposition process
- 3 Material evaporation methods
- 4 The substrate
- 5 Ion beam assisted deposition
- 6 Advantages of EBPVD
- 7 Disadvantages of EBPVD
- 8 References

Introduction

Thin film deposition is a process applied in the semiconductor industry to grow electronic materials, and in the aerospace industry to form thermal and chemical barrier coatings to protect surfaces against corrosive environments and to modify surfaces to have the desired properties.The deposition process can be broadly classified into physical vapor deposition (PVD) and chemical vapor deposition (CVD). In CVD, the film growth takes place at high temperatures, leading to the formation of corrosive gaseous products, and it may leave impurities in the film. The PVD process can be carried out at lower deposition temperatures and without corrosive products, but deposition rates are lower and it leaves residual compressive stress in the film. Electron beam physical vapor deposition, however, yields a high deposition rate from 0.1 μm / min to 100 μm / min at relatively low substrate temperatures, with very high material utilization efficiency. The schematic of an EBPVD system is shown in Fig 1.

Thin film deposition process

In an EBPVD system, the deposition chamber is evacuated to a pressure of 10^{-4} Torr. The material to be evaporated is in the form of ingots. There are as many as six electron guns, each having a power from few tens to hundreds of kW. Electron beams can be generated by thermionic emission, field electron emission or the anodic arc method. The generated electron beam is accelerated to a high kinetic energy and focused towards the ingot. When the accelerating voltage is between 20 kV – 25 kV and the beam current is a few amperes, 85% of the kinetic energy of the electrons is converted into thermal energy as the beam bombards the surface of the ingot. The surface temperature of the ingot increases resulting in the formation of a liquid melt. Although some of incident electron energy is lost in the excitation of X-rays and secondary emission, the liquid ingot material evaporates under vacuum.

The ingot itself is enclosed in a copper crucible, which is cooled by water circulation. The level of molten liquid pool on the surface of the ingot is kept constant by vertical displacement of the ingot.

The

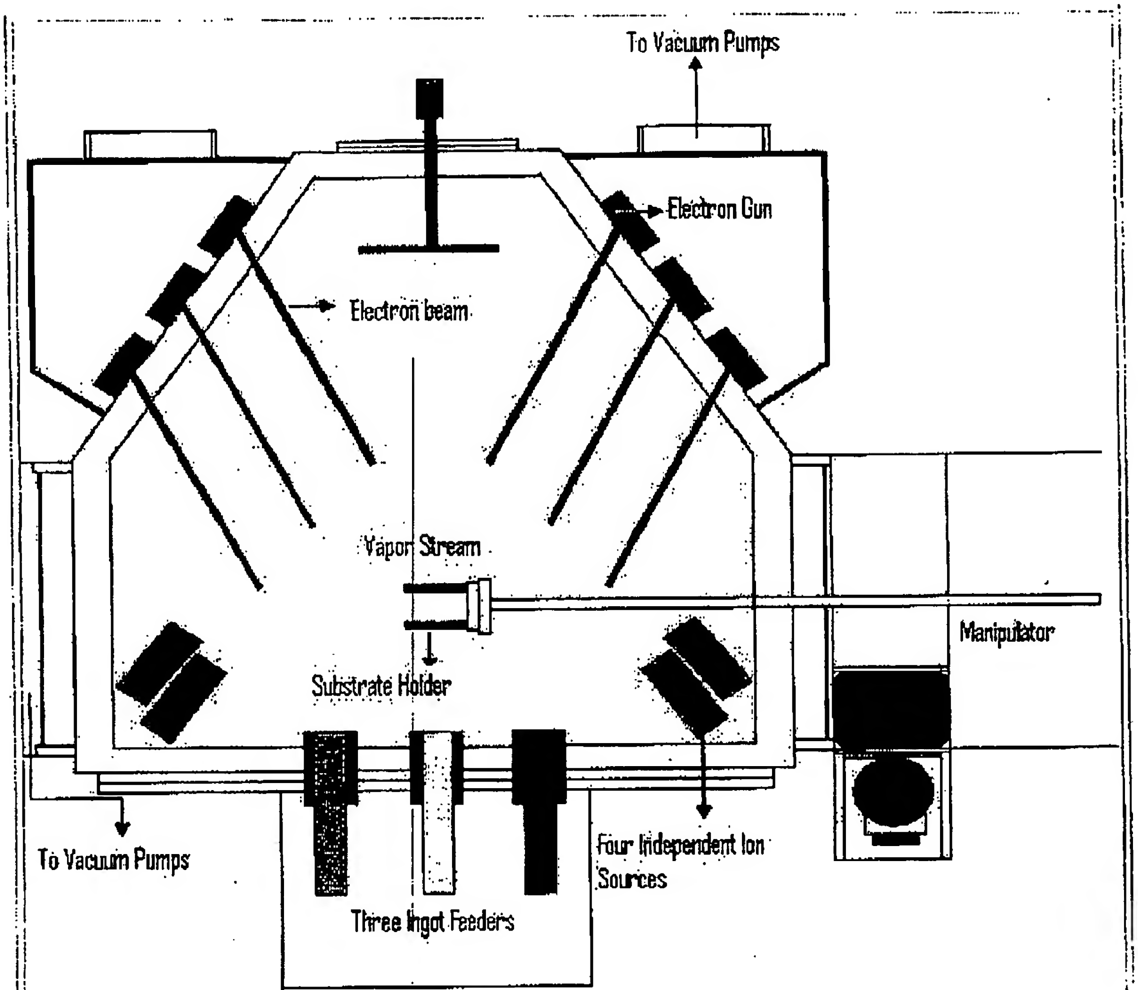


Fig 1 Electron Beam Physical Vapor Deposition

number of ingot feeders depends upon the material to be deposited. The evaporation rate may be of the order of 10^{-2} g/cm2 sec.

Material evaporation methods

Refractory carbides like titanium carbide and borides like titanium boride and zirconium boride can evaporate without undergoing decomposition in the vapor phase. These compounds are deposited by direct evaporation. In this process these compounds, compacted in the form of an ingot, are evaporated in vacuum by the focused high energy electron beam and the vapors are directly condensed over the substrate.

Certain refractory oxides and carbides undergo fragmentation during their evaporation by the electron beam, resulting in a stoichiometry that is different from the initial material. For example, alumina, when evaporated by electron beam, dissociates into aluminum, AlO_3 and Al_2O. Some refractory carbides like silicon carbide and tungsten carbide decompose upon heating and the dissociated elements have different volatilities. These compounds can be deposited on the substrate either by reactive evaporation or by co-evaporation. In the reactive evaporation process, the metal is evaporated from the ingot by the electron beam. The vapors are carried by the reactive gas, which is

oxygen in case of metal oxides or acetylene in case of metal carbides. When the thermodynamic conditions are met, the vapors react with the gas in the vicinity of the substrate to form films. Metal carbide films can also be deposited by co-evaporation. In this process, two ingots are used, one for metal and the other for carbon. Each ingot is heated with a different beam energy so that their evaporation rate can be controlled. As the vapors arrive at the surface, they chemically combine under proper thermodynamic conditions to form a metal carbide film.

The substrate

The substrate on which the film deposition takes place is ultrasonically cleaned and fastened to the substrate holder. The substrate holder is attached to the manipulator shaft. The manipulator shaft moves translationally to adjust the distance between the ingot source and the substrate. The shaft also rotates the substrate at a particular speed so that the film is uniformly deposited on the substrate. A negative bias D.C. voltage of 200 V – 400 V is applied to the substrate Focused high energy electrons from one of the electron guns preheat the substrate.

Ion beam assisted deposition

EBPVD systems are equipped with ion sources. These ion sources are used for substrate etching and cleaning, sputtering the target and controlling the microstructure of the substrate. The ion beams bombard the surface and alter the microstructure of the film. When the deposition reaction takes place on the hot substrate surface, the films develop an internal tensile stress due to the mismatch in the coefficient of thermal expansion between the substrate and the film. High energy ions can be used to bombard these ceramic thermal barrier coatings and change the tensile stress into compressive stress. Ion bombardment also increases the density of the film, changes the grain size and modifies amorphous films to polycrystalline films. Low energy ions are used for the surfaces of semiconductor films.

Advantages of EBPVD

The deposition rate in this process can be as low as 1 nm per minute to as high as few micrometers per minute. The material utilization efficiency is high relative to other methods and the process offers structural and morphological control of films. Due to the very high deposition rate, this process has potential industrial application for wear resistant and thermal barrier coatings in aerospace industries, hard coatings for cutting and tool industries, and electronic and optical films for semiconductor industries.

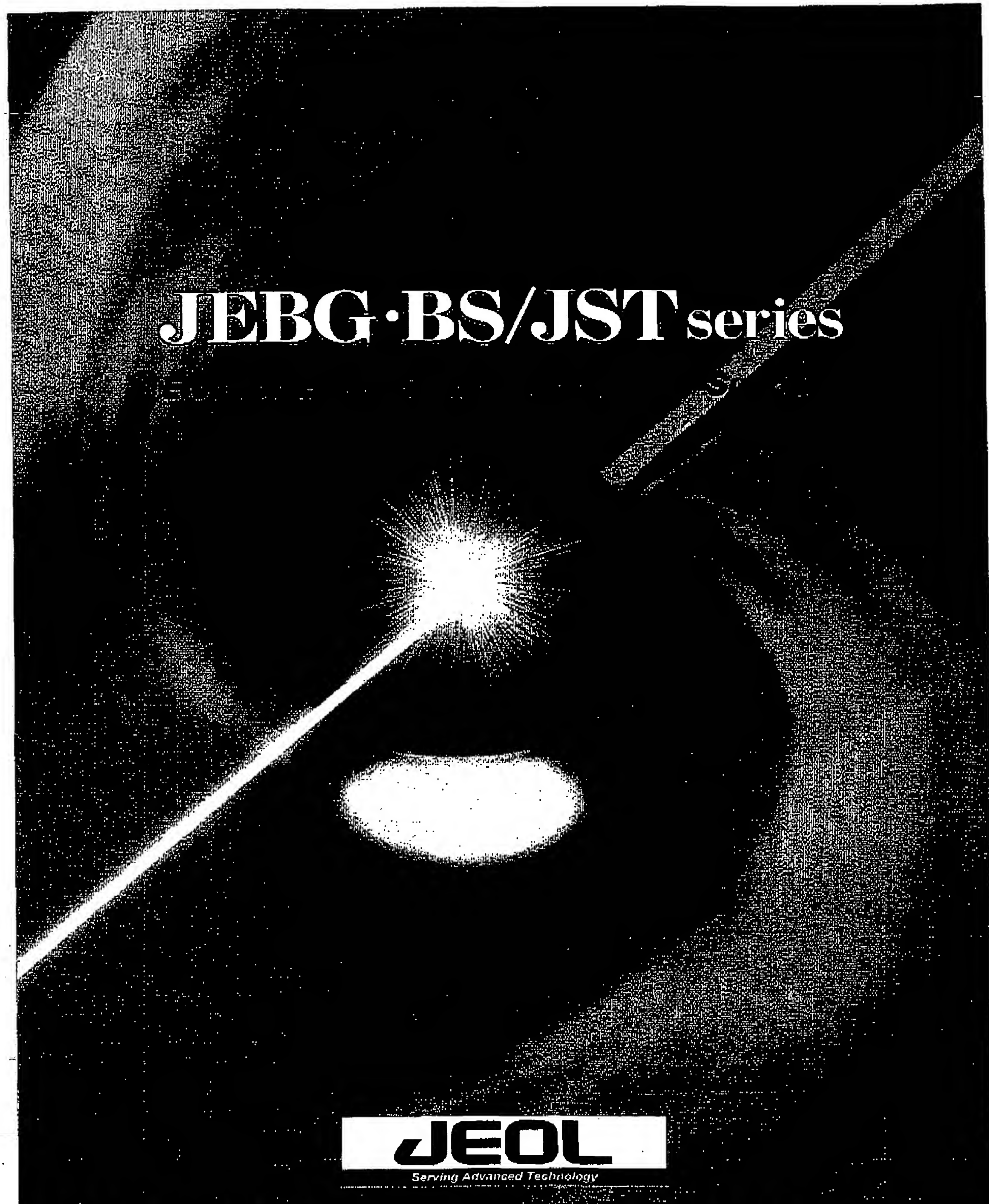
Disadvantages of EBPVD

EBPVD is a line-of-sight of deposition process. The translational and rotational motion of the shaft helps for coating the outer surface of complex geometries, but this process cannot be used to coat the inner surface of complex geometries. Another potential problem is that filament degradation in the electron gun results in a non-uniform evaporation rate.

References

1. D. Wolfe, Thesis (Ph.D), Thesis 2001dWolfe,DE, Synthesis and characterization of TiC, TiBCN,TiB_2 /TiC and TiC/CrC multilayer coatings by reactive and ion beam assisted, electron beam-physical vapor deposition (EB-PVD) The Pennsylvania State University, 1996.
2. Movchan, B. A. (2006). *Surface Engineering*. **22**. pp. 35–46.
3. Wolfe, D.; J. Singh (2000). *Surface and Coatings Technology*. **124**. pp. 142–153.

Retrieved from "http://en.wikipedia.org/wiki/Electron_beam_physical_vapor_deposition"
Categories: Thin film deposition


JEBG·BS/JST series
JEOL
Serving Advanced Technology

JEOL Meets Any Industrial Needs

JEBG/BS/JST Series
Electron Beam Sources and Power Supplies

Since its foundation, JEOL [illegible] ... technolo- [illegible] ... ment in its [illegible] ... beam sources [illegible] ... They [illegible] ... stability and [illegible] ... the optical [illegible] ... your diverse [illegible] ...

Features of Electron Beam Evaporation

- [illegible] ... thermal efficiency [illegible] ... such as W, Ta, and Mo and [illegible] evaporated.
- [illegible] ... like resistance heat- [illegible] ... react with the [illegible] ...
- [illegible] ...

Features of JEOL Electron Beam Sources and Power Supplies

- [illegible] ...
- [illegible] ...
- [illegible] ...

[illegible] ... Electron Beam Sources [illegible] ...

High Voltage [illegible] ... 6

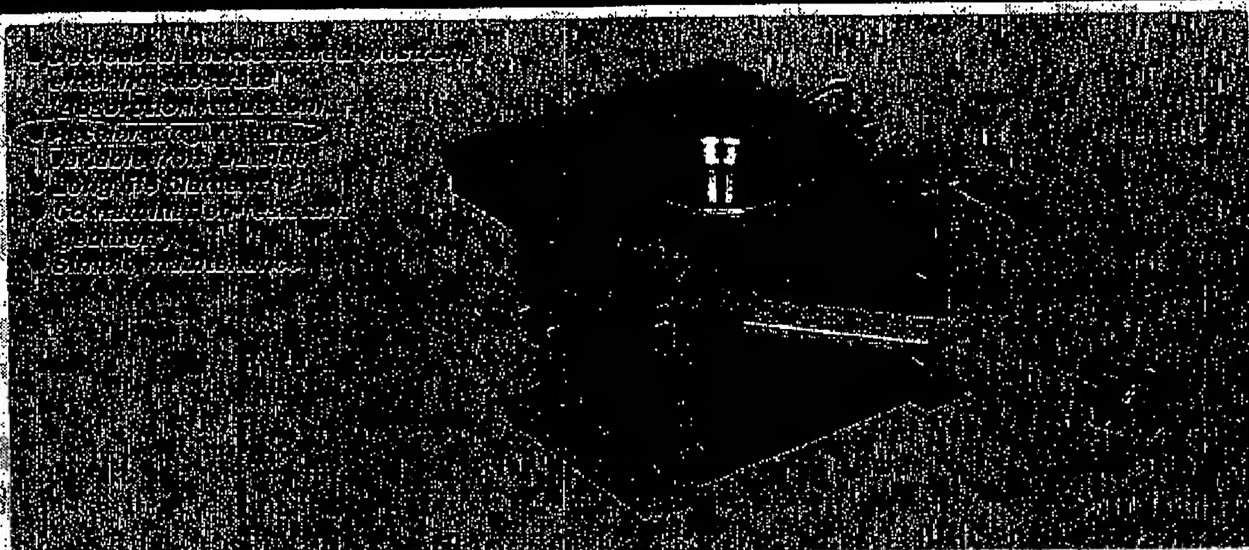
[illegible] ... 8

Various Controllers (operation unit, [illegible] source controller, two point controller) ... 14

Installation Requirements of Electron Beam Sources [illegible]

BS-6005[illegible]

Electron Beam Source [illegible] Reduced Backs[illegible]



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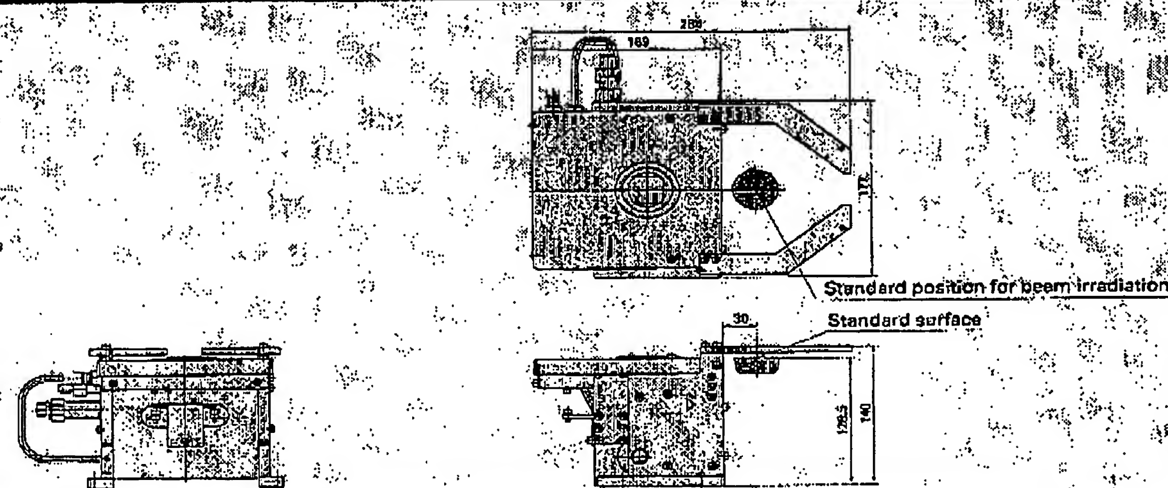
Unit : mm

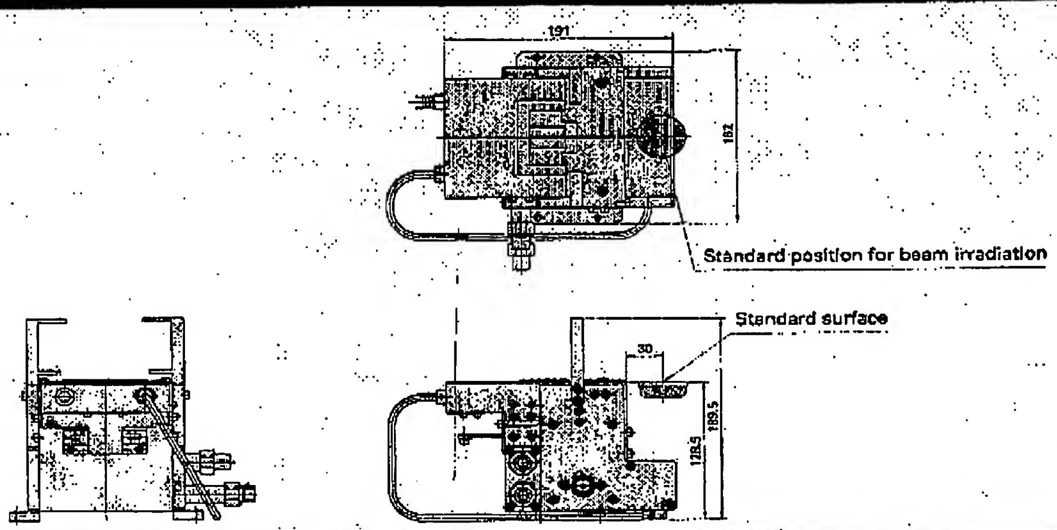


Specifications

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible] (water temperature [illegible] 25°C) Pressure difference [illegible]
[illegible]	[illegible] × 140 [illegible]
[illegible]	Approximately 14kg
[illegible]	[illegible] UST-16F

External dimensions

Unit : mm



Specifications

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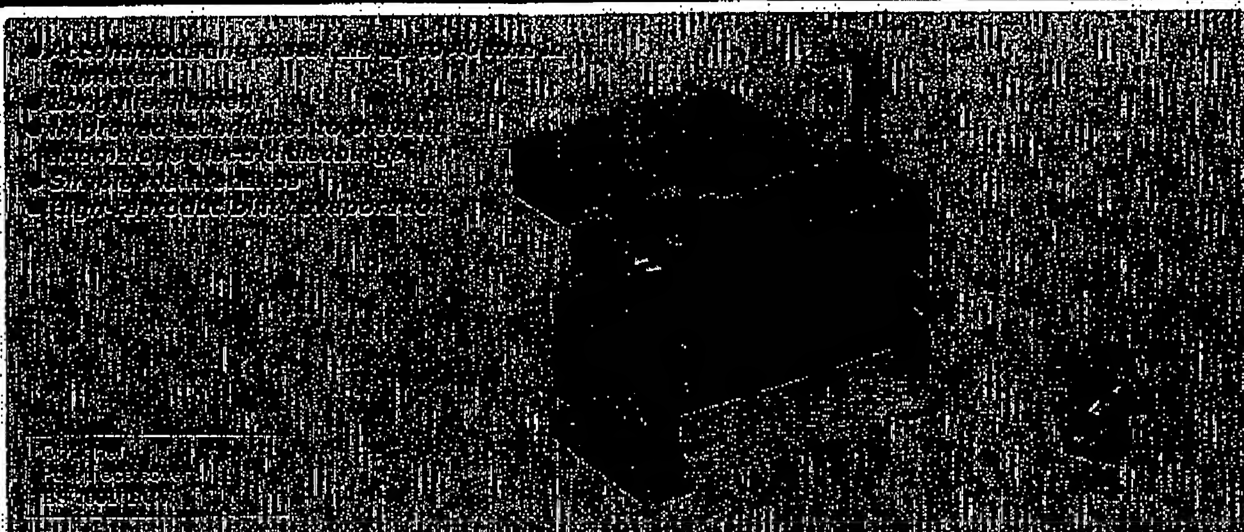
[illegible]	[illegible]
[illegible]	[illegible] permanent magnet and electromagnet [illegible]
[illegible]	Max. [illegible] mA (at [illegible] kV)
[illegible]	Max. [illegible] mA (at [illegible] kV)
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	5 to 8 L/min (water temperature: 10 to 25 °C), Pressure difference: 0.15 to 0.3 MPa
[illegible]	162 (W) × 191 (D) × 189.5 (H) mm
[illegible]	Approximately 10 kg
[illegible]	JST 3E, JST 10P, JST 16P

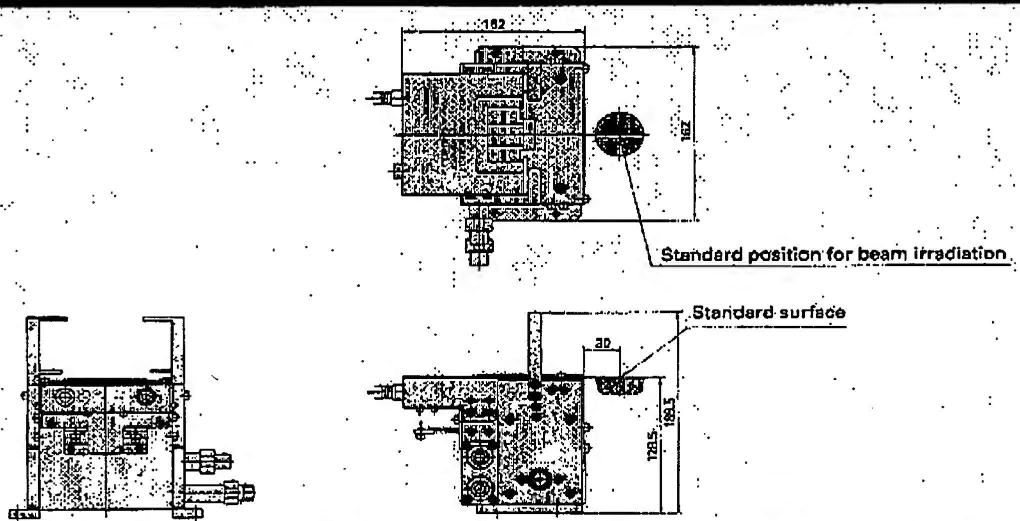
BS-60030 [illegible]

Electron Beam Source



External dimensions

Unit: mm



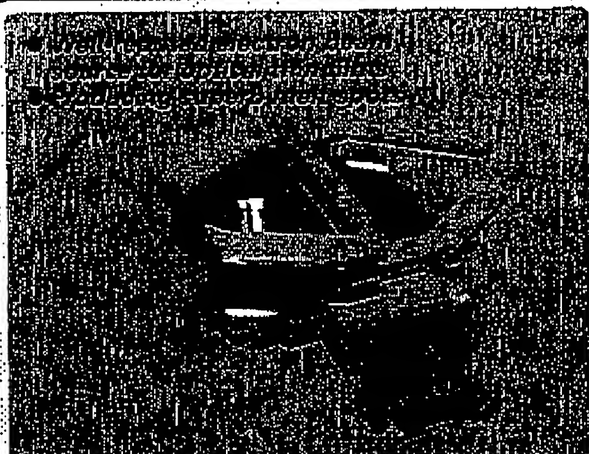
Specifications

[illegible]	10 kW (1 A at 10 kV) [illegible]
[illegible]	270° (permanent magnet [illegible])
[illegible]	Max. [illegible]
[illegible]	Max. [illegible]
[illegible]	Not included
[illegible]	7.6 × 10 [illegible]
[illegible]	[illegible] L/min (water temperature [illegible] 25°C), Pressure difference [illegible]
[illegible]	162 (W) × 152 (D) × 189.5 (H) mm
[illegible]	[illegible]
[illegible]	JST-3F, JST-10F, JST-18F

→ see page 11.

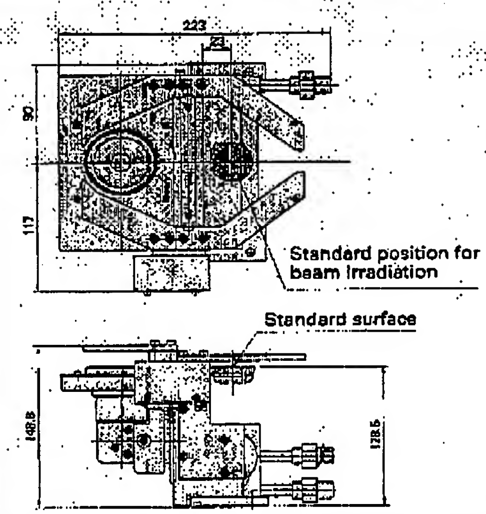
JEBG-102UHO

Electron Beam Source



External dimensions

Unit : mm



Specifications

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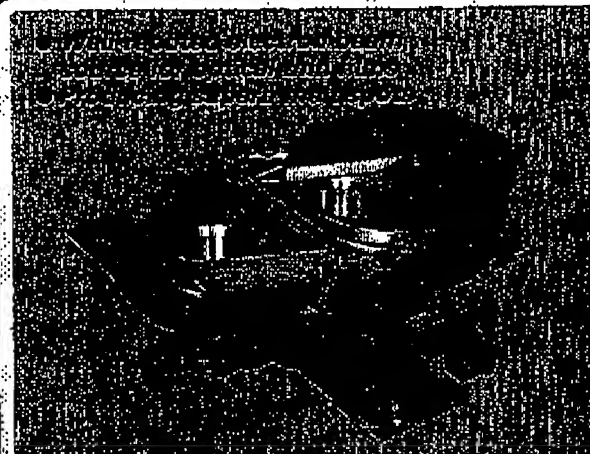
[illegible]	180° (electromagnet)
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	Not included
[illegible]	[illegible]
[illegible]	[illegible] Water temperature: 10 to 25 °C Pressure difference: [illegible]
[illegible]	[illegible] × 223(D) × 148.8(H) (including terminal box, water inlet)
[illegible]	Approximately [illegible]
[illegible]	JST-3F, JST-10F, JST-16F

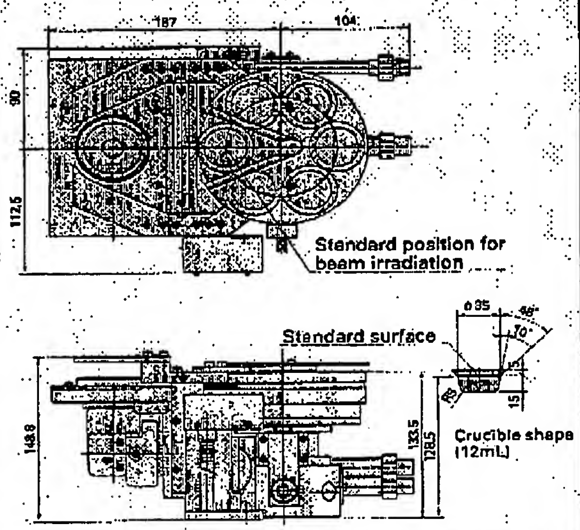
EBG-102UB6S
EBG-102UB4S

Electron Beam Source



External dimensions

Unit : mm



Specifications

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[illegible]	[illegible]	
[illegible]	12mL × 6 pockets	12mL × 4 pockets
[illegible]	[illegible]	
[illegible]	[illegible] Water temperature: 10 to 25 °C Pressure difference: [illegible]	
[illegible]	[illegible] (including water inlet)	
[illegible]	Approximately [illegible]	
[illegible]	JST-3F, JST-10F, JST-16F	

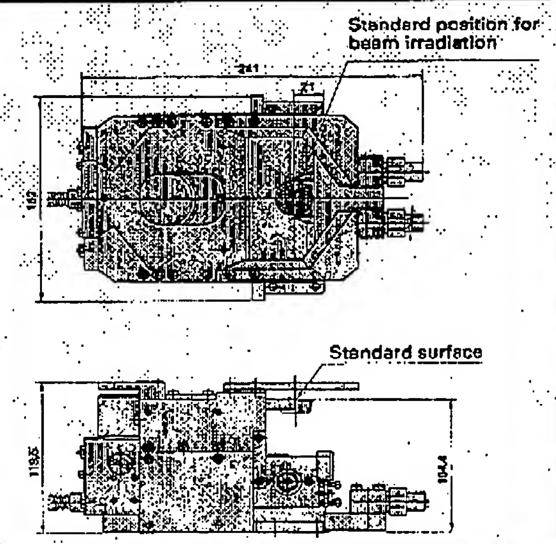
See page 11

JEBG-203UA[illegible]
Electron Beam Source

EBG-203UB4H
EBG-203UB6S
[illegible]

External dimensions

Unit : mm



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[illegible]	[illegible]
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[illegible]	[illegible] (bearing water inlet)
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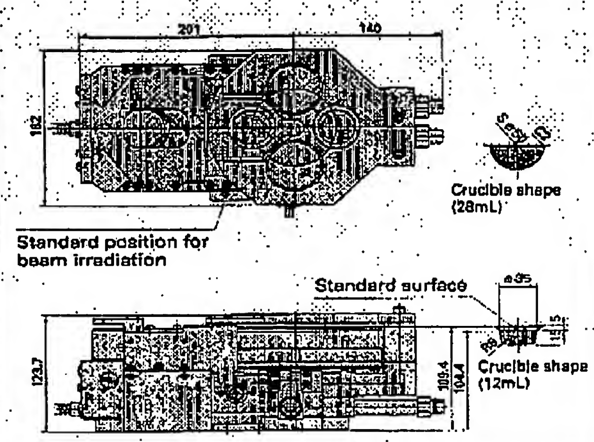
See page 11

External dimensions

Unit : mm



Specifications

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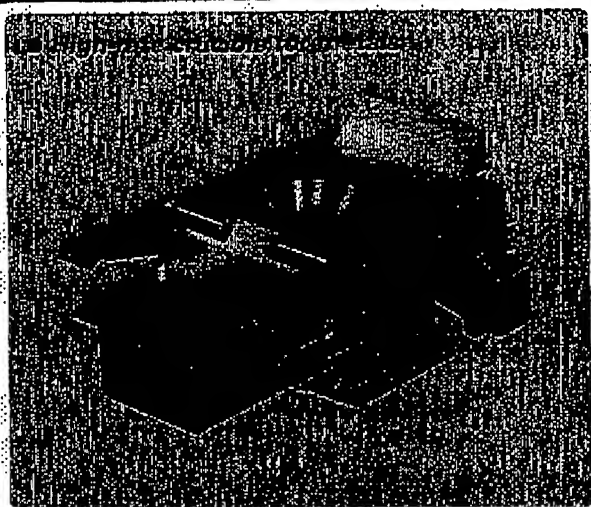
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible] pressure difference: 0.15 to 0.3 MPa
[illegible]	[illegible] (including water [illegible])
[illegible]	[illegible] Approximately [illegible] kg
[illegible]	JST-3F, JST-10F, JST-16F

See page 11

JEBG-163MB
Electron Beam Source



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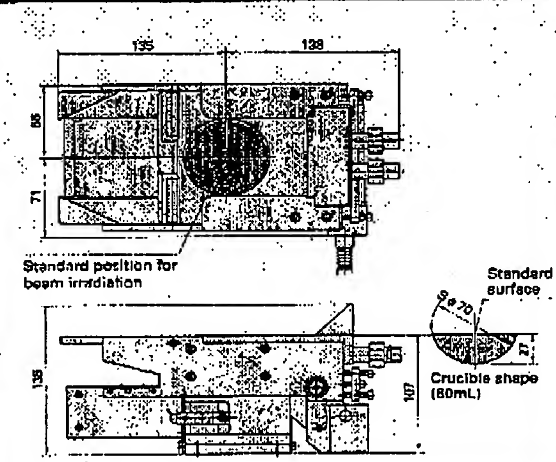
Unit : mm



Specifications

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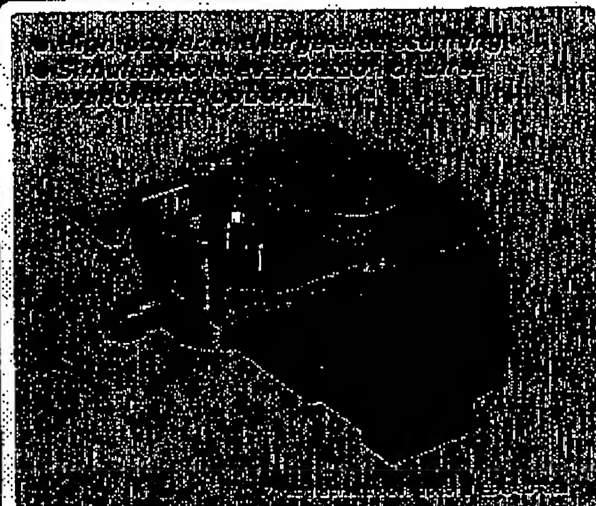
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible] (Water temperature: [illegible] to 25 °C) [illegible]
[illegible]	[illegible] (including water inlet)
[illegible]	Approximately [illegible]
[illegible]	JST-[illegible], JST-[illegible]

see page 11

JEBG-[illegible]
Electron Beam Source



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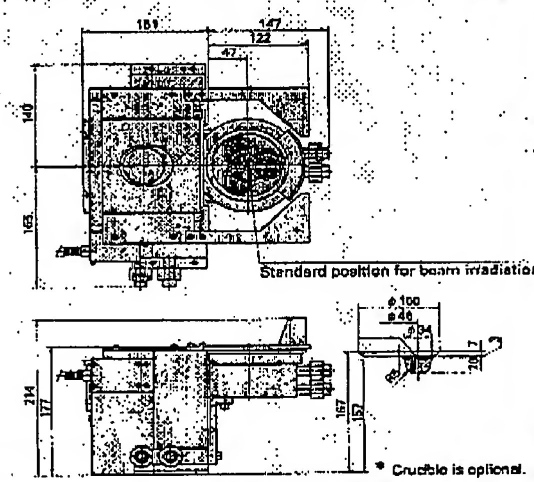
Unit : mm



Specifications

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[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	JST-10F, JST-[illegible]

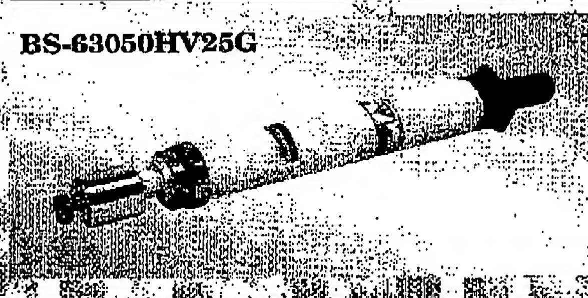
see page 11

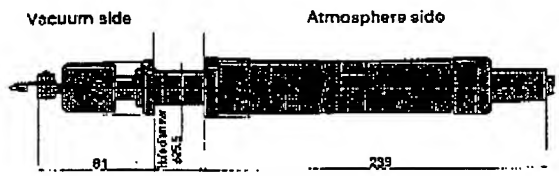
High Voltage Feedthrough / Low Voltage Feedthrough /Filament and Grid Assemblies

High Voltage Feedthrough

Unit : mm

BS-63050HV25G

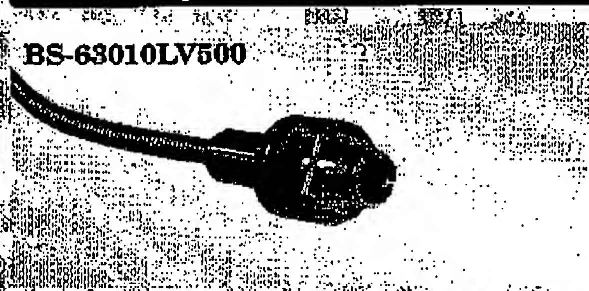


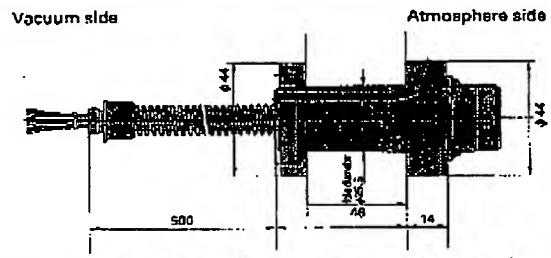


Low Voltage Feedthrough

Unit : mm

BS-63010LV500





Filaments

Parts No.

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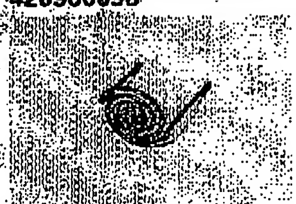
10PCS/CA

420900098



PB438124△4 D=0.8ϕ
10PCS/CA

801247683

PB438168 D=0.8ϕ
10PCS/CA

812180313

D=0.55ϕ
5PCS/CA

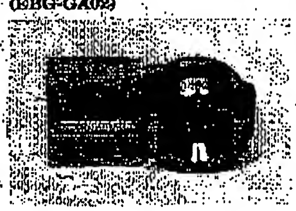
Grid Assemblies

Parts No.

7804 49746
(EBG-102GA)

For 102UHO/102UB

7804 49754
(EBG-GA02)



For 203

7894 00481

For 60030/60040

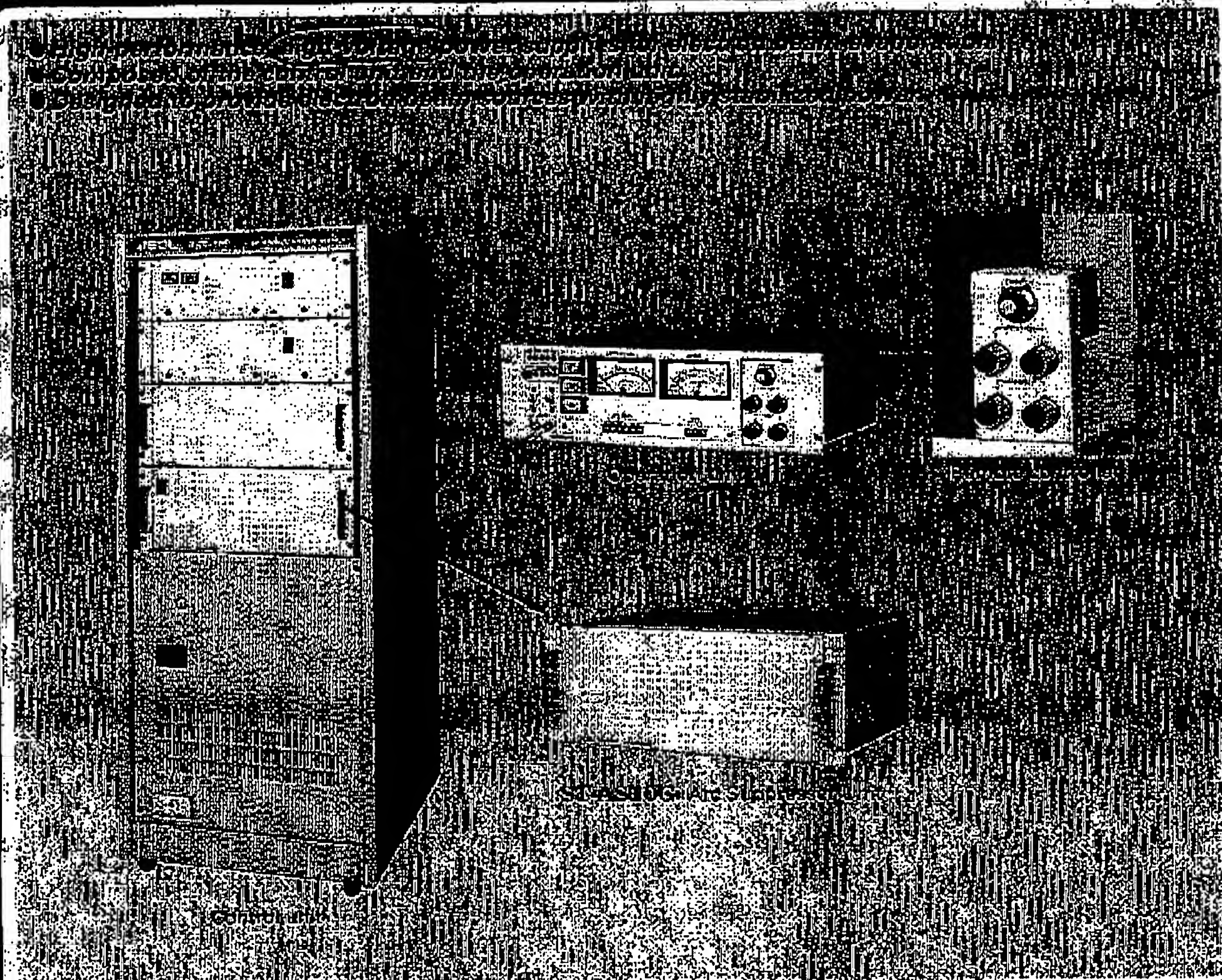
7804 05251

For 60050

When you want to order filaments or grid assemblies, please contact JEOL DATUM Ltd.
Parts Administration Group : TEL +81-42-542-1192 FAX +81-42-546-0307

JST-F series

EB Source Power Supplies



Features

- **Energy-saving power supplies using SCR control.**
- **Can readily be configured to a computer-controlled system.**
  Number of external I/O terminals INPUT 14 (standard), 25 (optional)
  OUTPUT 9 (standard), 7 (optional)
- **Remote controller provided as standard.**
  The emission, X-Y positioning, and X-Y scan width setting controls are attached to the controller by a magnet catch. Removing the magnet catch and fitting an extension cable will offer you a remote controller.
- **Arc suppresser unit (ST-AS10G) provided as standard.**
  Anomalous electric discharge can be suppressed rapidly.
- **Many options can be installed.**
  Selected or divided use of two electron-beam sources, power control by external signals, and 2-point or 3-point electron-beam scanning control can be used simply by adding optional units.
- **Power trouble and abnormalities detected and displayed with LEDs.**

Specifications

		JST-3F	JST-10F	JST-16F
[illegible]	[illegible]	6kW	10kW	16kW
	[illegible]	DC −4 to −8 kV	DC −4 to −10 kV	
	[illegible]	0 to 0.8A	0 to 1A	0 to 1.6A
	[illegible]	0 to 40A (maximum)		
	[illegible]	1.5% or less at maximum output		
[illegible]	[illegible]	0 to 2A		
	[illegible]	X axis (50 Hz), Y axis (500 Hz), Maximum output 5Ap-p, ±2A DC		
[illegible]	[illegible]	POWER ON/OFF, ACC ON, FIL ON, GUN OFF, INT/EXT		
	[illegible]	Above switches display, ALARM (4 points), INTERLOCK (Ext 3 points, INT 5 points)		
	[illegible]	3 ranges switching (0 to 120mA, 0 to 720mA, 0 to 2250mA)		
	[illegible]	Accelerating Voltage, Deflection current, X-Y position and X-Y scanning can be switched		
[illegible]		Input 14 points, output 9 points		
[illegible]		3-phase 200V, 10kVA	3-phase 200V, 15kVA	3-phase 200V, 25kVA
[illegible]	[illegible]	570 (W) × 780 (D) × 1,645 (H) mm		
	[illegible]	481 (W) × 300 (D) × 150 (H) mm		
[illegible]		Approximately 360	Approximately 362	Approximately 450
[illegible]		Less than ground resistance (10 Ω or less)		
[illegible]	[illegible]	ST-203, ST-202		
	[illegible]	ST-EXTSIG (Check of ACC, Emission, Scanning, Position, etc.)		
	[illegible]	BS-84010SCT		
	[illegible]	ST-2PNS (F), ST-TRIPLE (F), etc.		

ST-AS10G Arc Suppressor Unit

The ST-AS10G rapidly suppresses anomalous electric discharge during electron beam evaporation. In addition, this unit suppresses the noise arising during electric discharge and prevents evaporation from being interrupted.

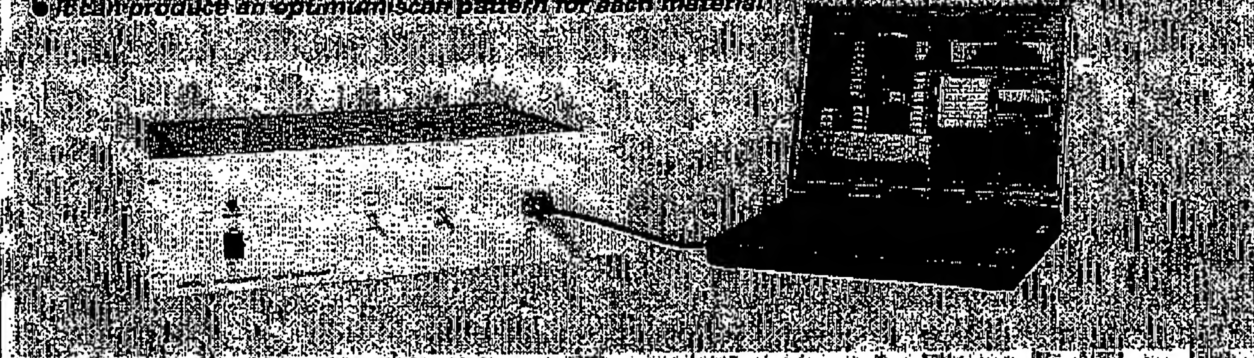
Applicable accelerating voltage and emission current	4 to 10kV, 1.6A
Vacuum pressure of vacuum evaporation chamber	6×10^{-2} Pa or less
Electron beam intermission time	0.5ms or less
Accelerating voltage over shoot when restored	20% or less, 3ms or less

Specifications subject to change without prior notice.

BS-64010SCT

Scan Controller

- *This is a tool to control melt spot.*
- *It can produce an optimum scan pattern for each material.*



Features

The software can provide an easy control of scan pattern visually, which used to be cumbersome and time-consuming

- Setting of the optimum scan pattern for each material is possible.
- The dwell time of beam spot can be adjusted visually.

Four modes are selectable

- Normal XY scan mode, circle mode, arbitrary position mode and line scan mode.

The controller can memorize 15 scan patterns per electron beam source. You can store optimum scan patterns for each material.

- Even when scan patterns are changed, it is not necessary to change the boards inside the power supply.
- The PC can be disconnected from the controller after scan patterns are memorized in the built-in memory.
- The controller can memorize 15 patterns per electron gun. So, 30 patterns can be memorized when two electron guns are used.

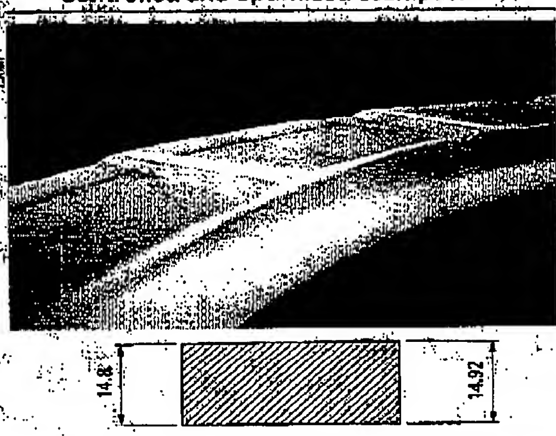
A variety of settings are also position, scan, offset, scan frequency, tilt angle

Example and optimized scan pattern

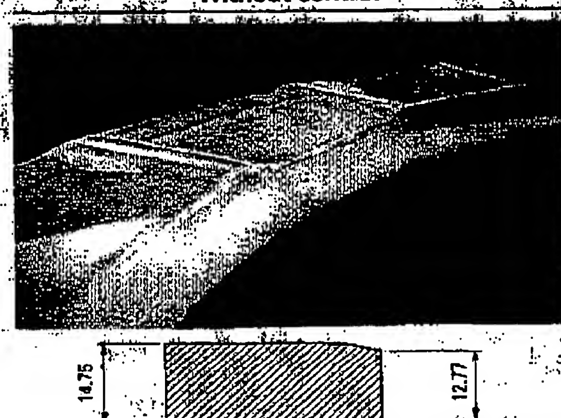
Unit : mm

Controlling the scan pattern has improved melt spot of quartz.

Controlled and optimized scan pattern



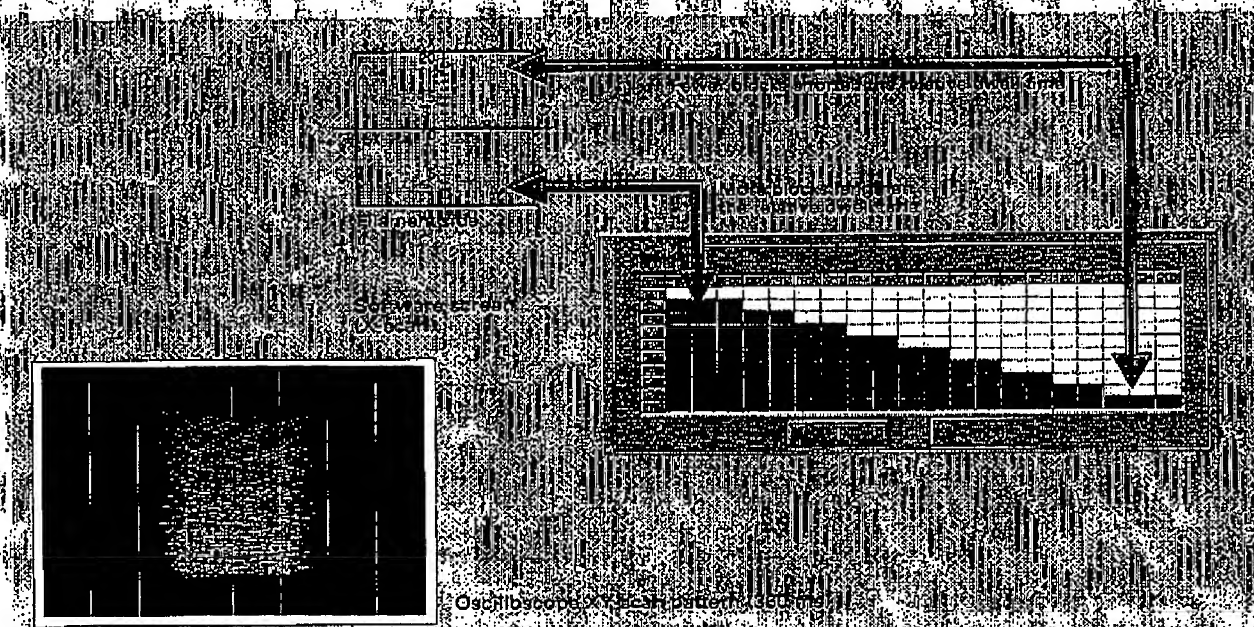
Without control



(Thickness of cross section in micrometers.)

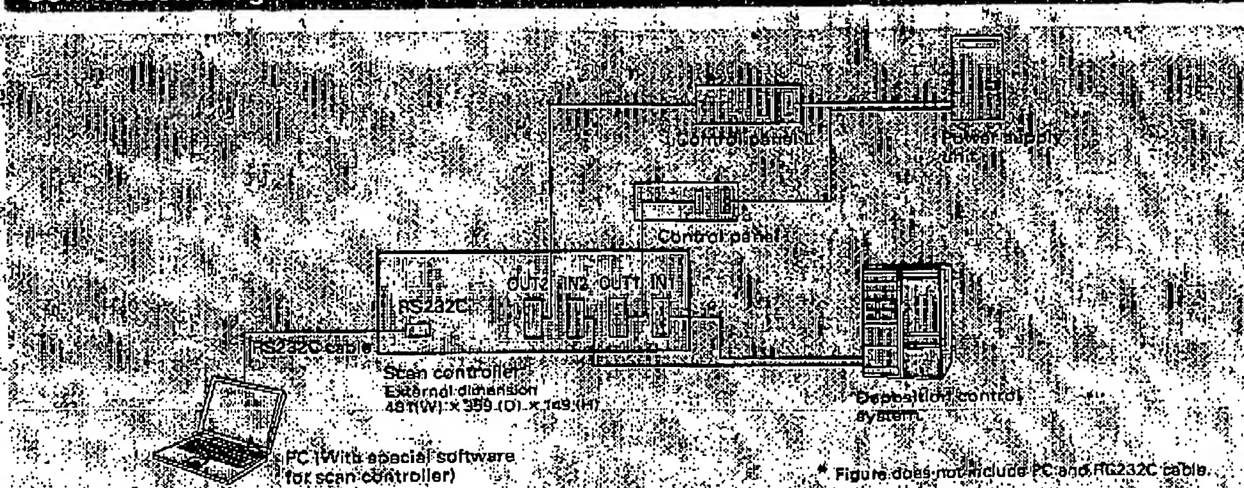
Example of Scan Pattern Setting

The controller divides the scan field in the X direction into 20 points, and sets the relative dwell time of the beam for each scan point.
The figure below shows one example. Here, the controller sets a relatively short dwell time in the back and a longer dwell time in the front (the filament side).
As the number of blocks increases, the dwell time becomes longer.



Connection Diagram

Unit: mm

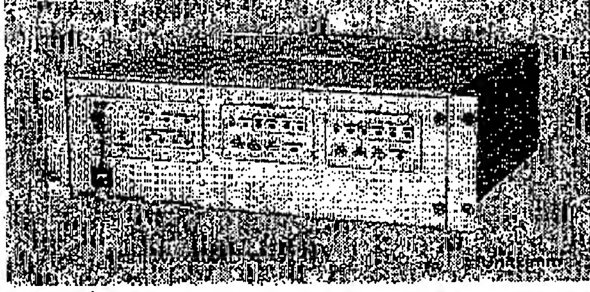


* Figure does not include PC and RG232C cable.

BS-64061OPE

DeviceNet Operation unit

- Compatible with DeviceNet communication and RS-232C communication
- Control function (operation unit) for two electron beam sources housed in one unit
- Pattern operation and residual-field erasing functions



This operation unit controls the JST-F series power supplies via DeviceNet communication. Can replace an existing operation unit for the JST-F series power supplies with this operation unit.

Features

- One unit incorporates a control function for two electron beam sources.
- DeviceNet communication enables external PC control or sequencer control.
- Conventional remote control is replaced by PC control via RS-232C communication.
- Accelerating voltage and deflection current can be externally controlled (JEBG-102 series, BS-60040VDGN, BS-60050EBS and JEBG-163MB).
- Incorporates a residual-field erasing function.
- Various patterns can be operated (filament annealing, melting down, etc.).*
- Scan Controller can be externally controlled (possible to specify scan pattern).
- Emission-current control can be selected from DeviceNet control and analog control (0 to 10 V).
- Incorporates a filament-monitoring function (outputting Filament ON accumulation time and Filament current).
- Equipped with ST-EXTSIG external-signal control function.

* Customers are required to set pattern.

Other Attachments for Power Supplies

- **ST-203 EB source divider**
  (corresponding power supply: JST-10F, JST-16F)
  Operation unit: 2
- **ST-202 EB source selector**
  (corresponding power supply: JST-3F, JST-10F, JST-16F)
  Operation unit: 1
- **ST-EXTSIG External signal I/O**
  (corresponding power supply: JST-3F, JST-10F, JST-16F)

ST-TRIPLE (F)
ST-2PNS (F)

Controller

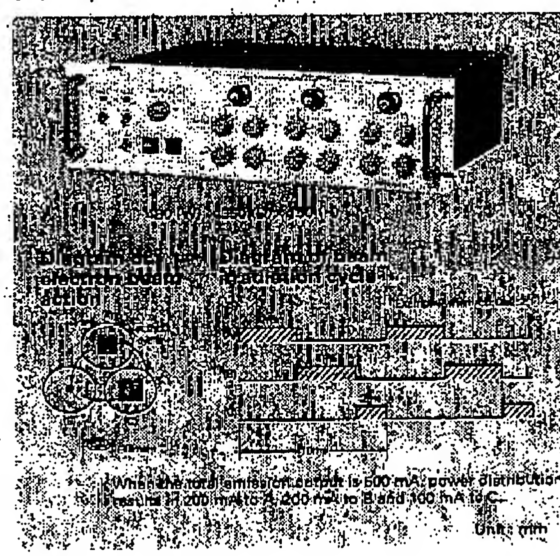
ST-TRIPLE (F) Triple source controller

(corresponding electron beam source: JEBG-303UA)

The triple source controller is attached to the power supply and enables simultaneous evaporation of three evaporants in one beam source. Electron beam is irradiated onto three pockets of a crucible at a high speed of 10 ms/cycle (1/100 sec) while scanning over each crucible pocket. In addition, you can set beam-irradiation position for the pockets and scan width arbitrarily.

Principle

Irradiation time of each beam A, B and C is determined by the set power rate signals (A: B: C). Then, superposing each scan signal on the power rate signals sets the beam positions and shapes.

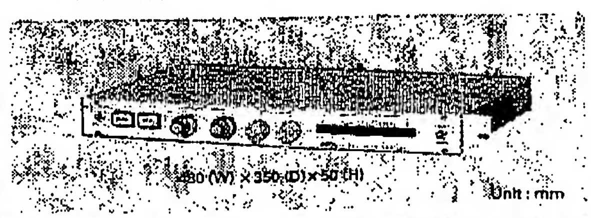


ST-2PNS (F) 2 point controller

(corresponding electron beam source: JEBG-102UB)

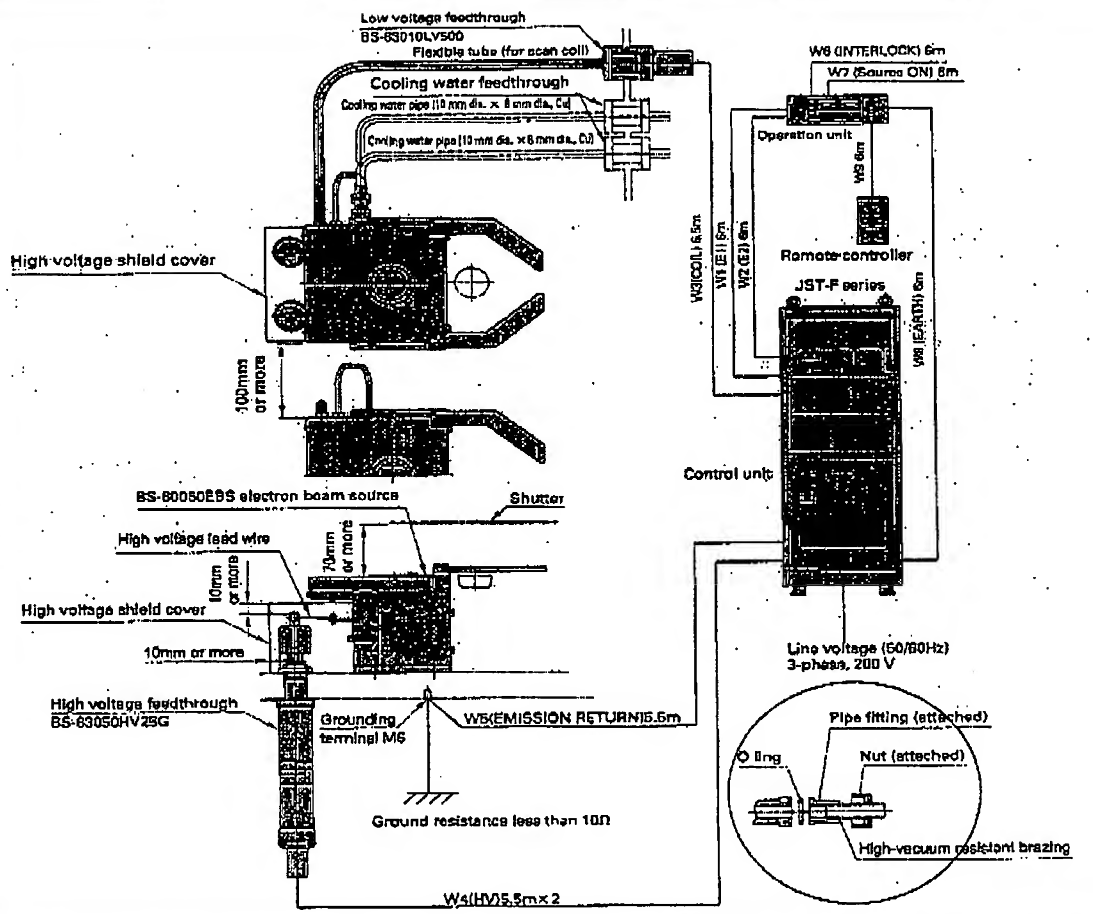
The 2 point controller is attached to the power supply and irradiates two points with an electron beam alternately, enabling simultaneous evaporation of two materials.

- Irradiation rate for two pockets can be changed from 100:1 to 1:100.
- In the two crucibles, it is possible to scan the electron beam at high speed for both X and Y axes.
- Crucible: maximum central clearance 20 mm, volume 2 mL for each.



Installation Requirements for Electron Beam Source

BS-60050EBS Reference diagram of electron beam source installation



* Standard cables (W1 to W9) are included in JST-F series power supplies.

Optional cable

[illegible]	W1 (E1), W2 (E2), W8 (ground)	10m for each
[illegible]	W1 (E1), W2 (E2), W8 (ground)	15m for each
[illegible]	W1 (E1), W2 (E2), W8 (ground)	20m for each
[illegible]	W1 (E1), W2 (E2), W8 (ground)	25m for each
[illegible]	W3 (coil), W4 (high voltage cable 2 (1 set))	10m for each
[illegible]	W3 (coil), W4 (high voltage cable 2 (1 set))	15m for each
[illegible]	W5 (emission return)	[illegible]
[illegible]	W5 (emission return)	15m
[illegible]	W5 (emission return)	20m
[illegible]	W6 (interlock), W7 (source ON)	[illegible]m for each
[illegible]	W9 (remote)	10m
[illegible]	W9 (remote)	15m
[illegible]	W9 (remote)	20m